

# Assessing the validity of impact pathways for child labour and well-being in social life cycle assessment

Andreas Jørgensen · Lufanna C. H. Lai · Michael Z. Hauschild

Received: 10 March 2009 / Accepted: 26 August 2009 / Published online: 27 November 2009  
© Springer-Verlag 2009

## Abstract

**Background, aim and scope** Assuming that the goal of social life cycle assessment (SLCA) is to assess damage and benefits on its ‘area of protection’ (AoP) as accurately as possible, it follows that the impact pathways, describing the cause effect relationship between indicator and the AoP, should have a consistent theoretical foundation so the inventory results can be associated with a predictable damage or benefit to the AoP. This article uses two concrete examples from the work on SLCA to analyse to what extent this is the case in current practice. One considers whether indicators included in SLCA approaches can validly assess impacts on the well-being of the stakeholder, whereas the other example addresses whether the ‘incidence of child labour’ is a valid measure for impacts on the AoPs.

**Materials and methods** The theoretical basis for the impact pathway between the relevant indicators and the AoPs is analysed drawing on research from relevant scientific fields.

**Results** The examples show a lack of valid impact pathways in both examples. The first example shows that depending on the definition of ‘well-being’, the assessment

of impacts on well-being of the stakeholder cannot be performed exclusively with the type of indicators which are presently used in SLCA approaches. The second example shows that the mere fact that a child is working tells little about how this may damage or benefit the AoPs, implying that the normally used indicator; ‘incidence of child labour’ lacks validity in relation to predicting damage or benefit on the AoPs of SLCA.

**Discussion** New indicators are proposed to mitigate the problem of invalid impact pathways. However, several problems arise relating to difficulties in getting data, the usability of the new indicators in management situations, and, in relation to example one, boundary setting issues.

**Conclusions** The article shows that it is possible to assess the validity of the impact pathways in SLCA. It thereby point to the possibility of utilising the same framework that underpins the environmental LCA in this regard. It also shows that in relation to both of the specific examples investigated, the validity of the impact pathways may be improved by adopting other indicators, which does, however, come with a considerable ‘price’.

**Recommendations and perspectives** It is argued that there is a need for analysing impact pathways of other impact categories often included in SLCA in order to establish indicators that better reflect actual damage or benefit to the AoPs.

---

Responsible editor: Andreas Ciroth

A. Jørgensen (✉) · M. Z. Hauschild  
Department of Management Engineering,  
Technical University of Denmark,  
Produktionstorvet 426, 2800,  
Kgs. Lyngby, Denmark  
e-mail: aj@ipl.dtu.dk

L. C. H. Lai  
School of Psychology, Faculty of Health, Medicine,  
Nursing and Behavioural Sciences, Deakin University,  
221 Burwood Highway,  
Burwood, Victoria 3125, Australia

**Keywords** AoP · Area of protection · Child labour · Impact pathways · Indicators · Objective indicators · SLCA · Social LCA · Subjective indicators · Well-being

## 1 Background, aim and scope

The inclusion of social aspects in an LCA methodology (SLCA) is a relatively new development within the LCA

community.<sup>1</sup> SLCA is not a well-defined method (Jørgensen et al. 2008), but still it is possible to outline some overall common characteristics. Most, if not all, SLCA approaches are based on an idea of what it is they want to protect or enhance, either by explicitly stating an ‘area of protection’ (AoP),<sup>2</sup> or for example by stating that the assessment measures degrees of social sustainability. The idea behind SLCA is in other words most often that if the assessment shows a better score, the assessed product or system is better in relation to the AoP or e.g. more socially sustainable than a product or system which gets a lower score. In other words, SLCA is often based on utilitarian ethics, where utility is defined by the AoP, implying that every aspect included in the assessment should be seen in relation to its impacts on the AoP.

Whether or not the entities that we want to protect or enhance have been explicitly defined as such in the existing work on SLCA, they will in this article simply be termed AoP. By adopting an AoP (implicitly or explicitly), most SLCA approaches more or less explicitly assume a range of causal relationships or impact pathways, as they are called in the environmental LCA literature, connecting the indicators we use in the assessment and the AoP. These impact pathways may be avoided if the entities we want to protect or enhance through applying the SLCA are simply defined in terms of the indicators we include in the assessment. But in this case, we would face the problem of ensuring that these indicators are, in fact, relevant for the stakeholders in the life cycle of the assessed product or service. This approach and the problems related to ensuring relevance will, however, not be discussed here.

Another and very obvious characteristic of SLCA is that we want to assess the social impacts created as a consequence of the life cycle of a product or service as accurately as possible. A central issue in relation to assessing as accurately as possible the damage on or benefits to the AoP, there has to be a valid<sup>3</sup> impact

<sup>1</sup> For earlier work on social aspects in LCA, see Benoît and Mazijn (2009); Klöpffer and Udo de Haes (2008); Jørgensen et al. (2008, 2009); Dreyer et al. (2006); Hunkeler (2006); Labuschagne and Brent (2006); Norris (2006); Weidema (2006); Gauthier (2005); Hunkeler and Rebitzer (2005); Schmidt et al. (2004); Klöpffer (2003). The reader may also refer to following sources: Earthster (2008); Flysjö (2006); Grießhammer et al. (2006); Manhart and Grießhammer (2006); Nazarkina and Le Bocq (2006); Barthel et al. (2005); Méthot (2005); Spillemaeckers et al. (2004)

<sup>2</sup> AoP is a term originally defined in environmental LCA to represent the classes of environmental endpoints that society wants to protect (Udo de Haes et al. 1999)

<sup>3</sup> An assessment will in this article be defined as ‘valid’ if the assessment measures what we intend to measure. An assessment method is valid if it allows for valid assessments. The degree of validity in other words defines the correspondence between reality and the assessment result. Validity is not to be confused with ‘reliability’ which ‘merely’ relates to reproducibility or the degree to which the result will always be the same if the assessment method is applied on the same situation. An assessment method can thereby be highly reliable without being valid whereas the opposite is not possible (Carmines and Zeller 1979).

pathway<sup>4</sup> between the indicators that are used to assess the damage or benefits from the life cycle and the AoP. If there is no valid impact pathway, there is no way of telling whether and to what extent the indicators that we apply in SLCA actually represent damage on or benefits to the AoP. A valid impact pathway in other words ensures that a certain indicator score has a certain, predictable impact on the AoP. The importance of well-founded impact pathways has long been accepted in environmental LCA (ELCA), yet it seems that in SLCA literature until now, valid impact pathways have gained little attention. This lack may imply that there is no theoretically well-founded relationship between the indicators included in many SLCA studies and the AoPs (whether the latter are explicitly defined in the studies or not). In this article, we analyse two different examples of validity problems in the impact pathways in existing SLCA approaches. The two examples take opposite perspectives when addressing the issue: The first example starts in the AoP end of the impact pathway and analyses whether the types of indicators that are used in the various SLCA approaches are actually able to validly assess damages or benefits to the AoP. The second example starts in the opposite end of the impact pathway near the inventory information by examining a specific indicator, which is often applied in SLCA approaches, and analysing whether this indicator actually assesses damage on or benefit to the AoPs of SLCA. The assessment of the validity of these (often implicit) impact pathways in SLCA is substantiated drawing on empirical findings from relevant fields of research.

Each example is followed by a short discussion of how shortcomings in terms of valid impact pathways may potentially be mitigated. However, as will become clear, an increased validity comes at a price that may be substantial.

<sup>4</sup> A question which arises is how we can validly assess social impact pathways. For this to make sense, we have to make a series of assumptions about the social world. First of all, we have to assume that the social world is real and that it can be examined and communicated accurately. If not, it does not make sense to say that an assessment of the social world resembles accurately the reality of the social world. The social world is by other words in this SLCA framework assumed real, measurable, communicable and independent of our measurements.

It does not serve the purpose of this article to discuss these positions towards the nature of the social world in any depth but we will however mention that opposite viewpoints are widespread throughout academia implying that several research paradigms within the social sciences would contest these assumptions. See for example Burrell and Morgan (1979) for a discussion of different research paradigms within the social sciences.

## 2 What is it we want to protect? Example 1: the well-being of the stakeholder

What we want to protect in an SLCA is as mentioned above defined by the AoP. A short review of articles and reports on SLCA published until now shows that the AoP of SLCA has been explicitly discussed in Weidema (2006); Dreyer et al. (2006); Nazarkina and Le Bocq (2006), and Schmidt et al. (2004). Benoît and Mazijn (2009) also include a discussion of an AoP, which is however called a ‘social endpoint’, but the meaning remains the same. Dreyer et al. (2006) and Weidema (2006) state that their AoPs focus on what could be termed the intrinsic value of the well-being of humans (in a broad notion). Well-being is also mentioned as the AoP by Benoît and Mazijn (2009). Schmidt et al. (2004) focus on the preservation or enhancement of different types of ‘societal capitals’, an approach based on the World Bank’s ‘four capitals approach’, which include social, human, and produced/physical capital besides natural capital. This approach is conceptualised with reference to national wealth and denotes the maintenance and enhancement of wealth for the present and future generations (World Bank 1997; Berger-Schmitt and Noll 2000). The definition of AoP by Nazarkina and Le Bocq (2006) explicitly relates to both well-being and the societal capitals. Weidema (2006) and Benoît and Mazijn (2009) also mention both categories, which they find being related (if these societal capitals are set to equal social sustainability, which is often the case) as it is stated that the ultimate objective of sustainable development is to maximise the well-being of humans. The societal capitals (or social sustainability) can thereby according to these authors be seen as subordinate to the overall goal of well-being of humans. In the present SLCA literature, the AoPs are thus defined as relating to the well-being of the individuals as it is affected by the life cycle of the assessed product or service (individual AoP), and to the wealth of the society (societal AoP). Table 1 categorises the mentioned SLCA approaches according to the AoP they apply.

In the approaches dealing with the individual AoP the meaning of well-being is not addressed in great detail. Yet, well-being has in literature on the subject been understood in several different ways. For example Galloway (2006) (on the basis of Veenhoven (1988)), outlines four different kinds of ‘being well’:

It is very possible that there may be other acceptable definitions of well-being and that this elaboration therefore is not a full account of the potential meanings. However, if we on the basis of this elaboration of well-being turn to the definitions given by Dreyer et al. (2006) and Weidema (2006), it may be noted that these are probably not related to ‘being of worth to the world’ since they mention the

intrinsic value of well-being and not this more instrumental understanding. Also, since Dreyer et al. (2006) mention ‘dignity’ and Weidema (2006) mention ‘anxiety’, which both seem to relate to the ‘inner’ rather than the ‘outer qualities’, their definition of well-being thus seem at least to include ‘inner qualities’. Nazarkina and Le Bocq (2006) on the other hand explicitly dismiss the understanding of well-being as defined by the ‘inner qualities’. Benoît and Mazijn (2009) also includes a discussion of well-being but do not come up with a clear definition of the term. However, words like happiness, life satisfaction, and affection are mentioned as aspects of well-being indicating that the ‘inner qualities’ are also seen as part of the well-being construct.

If well-being in the approaches by Dreyer et al. (2006); Benoît and Mazijn (2009) and Weidema (2006) should be understood as characterised by, or including, the ‘inner qualities’ in Table 2, i.e. as a person’s subjective experience of his/her own life, we can probably pin down its meaning (or part of its meaning) as it has been done in related research fields as: “life satisfaction, pleasant and unpleasant affect” (Diener and Suh 1997).<sup>5</sup> Assuming now that this is the case, we can draw on the experiences with the assessment of (impacts on) this ‘type’ of well-being, which has a long tradition in several fields of research, such as the fields of psychology and disability research (e.g. Shalock 1996; Cummins 2005), health research (WHO 1995) and social indicators research (e.g. Sirgy et al. 2006).<sup>6</sup> Here, this type of well-being is often denoted subjective well-being (SWB), which is a term that will be adopted in the remaining part of this article.<sup>7</sup>

Within these fields of research in the assessment of SWB, a distinction is made between objective and subjective indicators (see for example Sirgy et al. 2006). Objective indicators are indicators that are designed to measure impacts which can, at least potentially, be measured without the involvement of the experiences of the impacted stakeholder, for example, wages and working hours etc. Subjective indicators, on the other hand, are indicators that focus on the experiences or feelings of the impacted stakeholder.

<sup>5</sup> Many different but reasonably related definitions of this construct can be found. See for example Galloway (2006) for an overview.

<sup>6</sup> See also Martel and Dupuis (2006); Galloway (2006); Diener and Biswas-Diener (2002); Diener et al. (2002); Schalock et al. (2002); Michalos (2001); Cummins (2000); Felce and Perry (1996); Carley (1981)

<sup>7</sup> The mentioned literature deals with several different and closely related constructs. SWB is in some cases mentioned together with the term (subjective) ‘quality of life’, which by some is seen as identical to SWB and by some is seen as a broader construct. This article will utilise experience gained on ‘quality of life’ research without making a distinction between the terms when they are used in reasonably similar ways.

**Table 1** Two types of AoP definitions applied in current SLCA studies

Individual AoP	Societal AoP
Dreyer et al. (2006)	Nazarkina and Le Bocq (2006);
Weidema (2006)	Schmidt et al. (2004)
Nazarkina and Le Bocq (2006)	
Benoît and Mazijn (2009)	

An individual AoP indicates that the SLCA's goal is to assess impacts on the well-being of the individual. The societal AoP indicate that the goal of the SLCA is to assess the wealth of society in a broad notion. Some scholars claim that these goals are highly interlinked

Going through the actual indicators presented in the various SLCA approaches, it shows that only objective indicators are included. Assuming now that we are in fact interested in assessing well-being as outlined above and not another kind of well-being as illustrated in Table 2, there has to be a valid impact pathway connecting SWB with objective indicators.

This aspect has been addressed empirically several times in the above-mentioned fields of research mentioned. Here it shows that poor correlations are repeatedly found between the objective indicators and SWB (Cummins 2000; Diener and Biswas-Diener 2002). This is not to say that there is no correlation at all. For example, money may enhance life satisfaction (an aspect of SWB) when it means avoiding acute poverty whereas increase in income in developed countries has been accompanied by little rise in life satisfaction. This conclusion, that the rise of objectively measurable goods below a certain 'threshold' affects general life satisfaction, whereas a further increase above the threshold will only yield marginal results, seems to some extent general (Cummins 2000). In line with this Cummins (2000) argues that SWB is held under 'homeostatic' control, so that only changes to and from very poor objective life conditions will have a significant and lasting impact on SWB, implying that within a considerable range of objective living conditions SWB will not be significantly affected. The idea of creating a simple impact pathway between objective indicators and SWB of the stakeholder therefore is only valid in a very limited range of situations. Objective indicators can therefore to a limited extent be applied in the assessment of SWB but subjective indicators are central in obtaining a more valid assessment. Subjective indicators have gradually been refined so that presently there are indicators for assessing various aspects of the SWB with a good test-retest reliability and high internal consistency (Sirgy et al. 2006), indicating that a sound scientific basis has been established for these indicators. There is thus no immediate scientific basis for dismissing this type of indicators in SLCA.

Thus, if well-being defined in the individual AoP should be understood as SWB, it seems that including subjective

indicators in the assessment would improve the validity. However, several problems can be identified relating to their introduction.

From a practical perspective one problem relates to the availability of data. The inclusion of subjective indicators necessitates an assessment of the experience of the actually impacted stakeholder. This implies that an assessment has to be conducted in a highly site-specific way with an assessment of, for example, the actual worker. As already argued by Dreyer et al. (2006) and Spillemaeckers et al. (2004) this is not new to SLCA since also an assessment using only objective indicators calls for a site specific assessment. However, the objective indicators concerned often relate to the overall management of the company (Dreyer et al. 2006), and may therefore be on the company level rather than on the individual level which is required for subjective indicators. Furthermore, in some cases statistical databases may exist containing sector- and country-specific information on objective indicators for, e.g. work accidents or child labour, which would to some extent allow for 'desktop studies', significantly reducing the workload of performing an SLCA. From a practical perspective, data collection is likely to be a considerable task in performing SLCA (Jørgensen et al. 2009) and the use of subjective indicators is likely to intensify this problem.

Another problem of using subjective indicators relates to the use of SLCA results in management. By creating an overview of social impacts in the life cycle of a product or service, SLCA can be used for identifying important social impacts. The assessment may thereby serve as a basis for decision makers in order to manage the most significant social impacts in the product chain first. However, considering that a manager or policy maker can mainly change objective life conditions, such as changing or regulating the salary, working conditions, etc. and that there is a very weak correlation between SWB and the objective life conditions, this implies that impacts on the SWB will be less manageable than the objective life

**Table 2** Four different kinds of 'being well'

	Outer qualities	Inner qualities
Life chances	Living in a good environment	Being able to cope with life
Life results	Being of worth for the world	Enjoying life

The 'outer qualities' indicate qualities in an individual's life which can more or less readily be observed and appreciated by others than the individual. Well-being may in this conceptualisation both relate to what we have in terms of readiness to meet life's challenges and to what we have achieved. 'Inner qualities' are more related to how the individual sees itself which may also be described both in terms of what the individual sees itself as having of resources and as what it has achieved

conditions. Subjective indicators would therefore be difficult to be fully utilised in a potential management situation.

A third problem relates to the boundary setting of the assessment. As defined in the introduction, SLCA is typically about assessing the consequences of a product or service. The consequence can be formulated as the change from the situation with to the situation without the product or service, this change being allocated to the product or service. When assessing a product or service it is therefore important that we can differentiate between impacts that occur as a consequence of the product or service and impacts that cannot be attributed to it. In more practical terms, if we consider impacts on the worker, which has been a main focus in existing SLCA approaches (Jørgensen et al. 2008), this consequence has been interpreted as the impacts on the worker when he or she is working. We are thus interested in the impacts created in the work life, whereas impacts related to the non-work life is of no interest for the assessment. In SLCA where only objective indicators are used, it is relatively easy to distinguish where the impact occurs. To take an example, impacts related to the physical working conditions is something that occurs in the work life, and impacts from this activity can thus in a relatively easy manner be attributed the production of the assessed product. When applying subjective indicators, this division between work and non-work becomes more difficult. Not surprisingly, studies show that how the non-work life is experienced tends to be correlated to the experience of the work (Staines 1980; Rain et al. 1991; Tait et al. 1989). To take an example, if a person is dissatisfied with his or her life conditions in general, this dissatisfaction can influence how this person experiences the work life, or vice versa. When applying the subjective indicators to the work life, the assessment will therefore very easily be affected by the non-work life. In other words, the inclusion of subjective indicators would easily involve a boundary setting problem, as the boundaries for what is included in the assessment in relation to the subjective indicators will be extremely difficult to narrow down to only including the impacts arising from the work life. It is possible that the non-work life experiences can somehow be controlled for; however, how this control should be performed is far from clear. Including subjective indicators in SLCA would therefore almost inevitably create some level of inaccuracy in the assessment.

Based on this analysis, it can be argued that if well-being in SLCA should be understood as SWB or even merely as including SWB as part of the construct, problems of validity will easily emerge whether or not subjective indicators are included in the assessment.

On the other hand, if well-being should be more understood in line with ‘living in a good environment’ or ‘being of good to the world’ which are both explicitly

related to qualities external to the individual and therefore by definition related to only objective indicators, this problem of the subjective would be eliminated.

Another way to ‘handle’ the problem of SWB in SLCA, as pointed out by Matthias Finkbeiner, who among others reviewed this article, could be to adopt the same strategy as taken in ELCA. In ELCA, it is often the case that various emissions may not necessarily cause actual impacts. This problem has been ‘solved’ by relating emissions to ‘potential impacts’ rather than ‘actual impacts’. The very same strategy goes in relation to SLCA, where we could measure changes in objective living conditions by using objective indicators and simply speak of these as ‘potential impacts’ to well-being (here understood as SWB) rather than ‘actual impacts’.

## 2.1 Summing up on example 1

It was shown that several approaches define an AoP of SLCA as well-being. If well-being is understood in its probably most common form as a person’s subjective experience of his/her own life, the inclusion of subjective indicators will improve the validity of its assessment, at least until a better understanding of how well-being is affected by the objective living conditions is reached. This inclusion of subjective indicators is, however, related to practical, managerial and boundary setting problems relating to the inclusion of subjective indicators. Yet, if well-being is defined differently, as relating merely the world external to the individual, as done by Nazarkina and Le Bocq (2006), this would eliminate the problem, but would probably also imply that the meaning of well-being would be different from the most common understanding of the term.

## 3 How do we define the indicators? Example 2: indicators on child labour

In the first example, we have discussed the validity of impact pathways from a specific definition of the AoP and discussed whether the types of indicators that are used in the various SLCA approaches are actually able to assess damages or benefits to this AoP. We will now in example 2 address the validity of impact pathways from the ‘other end’ by taking a specific indicator and analyse whether valid impact pathways exists between this indicator and the various AoPs.

Child labour is often included in SLCA approaches, and a number of different indicators used to represent this impact category have been identified. Table 3 gives an overview of SLCA approaches which include child labour and their choice of indicators to represent this type of impact.

As may be noted, there is a relatively broad agreement that it is the incidence of child labour that should be

**Table 3** Overview of how SLCA approaches include child labour

Included by	Indicator
Barthel et al. (2005)	Seconds of child labour or hazardous child labour per produced unit. The assessment thereby focuses on the incidence of child labour or hazardous child labour
Dreyer et al. (2006)	The potential occurrence of child labour in a company based on a risk assessment of the company's management system. The assessment thereby focuses on the incidence of child labour
Manhart and Grießhammer (2006)	Incidence of child labour
Nazarkina and Le Bocq (2006)	Incidence of child labour
Schmidt et al. (2004)	Incidence of child labour (?)
Spillemaeckers et al. (2004)	The incidence of child labour and whether working children under 15 can attend school and are not performing hazardous work

As the indicators are not always present in the various available material, question marks are used to indicate when there is uncertainty of how the indicator is formulated

assessed in SLCA. Yet, Spillemaeckers et al. (2004) and Barthel et al. (2005) also consider school attendance and/or the exposure to hazardous work. Still, the ‘incidence of child labour’ is the most frequently used indicator on child labour in SLCA, and it is therefore relevant to examine to what extent this indicator gives a predictable impact on the AoP. In the following, the AoP will be deliberated in terms of its associated endpoint impact categories in order to establish impact pathways from the incidence of child labour to the AoP.

### 3.1 Establishing a model for the AoP and endpoint categories

As mentioned in Section 2 two ‘types’ of AoPs can be identified; one focusing on the well-being of the individual (Dreyer et al 2006; Weidema 2006; Nazarkina and Le Bocq 2006) and one focusing on the societal wealth (Schmidt et al. 2004; Nazarkina and Le Bocq 2006). We will first concentrate the analysis on the AoPs focusing on the individual well-being. ‘Societal AoPs’ will be discussed further below.

Dreyer et al. (2006) further elaborate the ‘individual AoP’ as to live a healthy and naturally long life, to live a decent life and enjoy respect and social membership, and to have access to food, water, clothes, medical care, etc. Weidema (2006) also elaborates on the AoP by including a list of endpoint impact categories comprising life and longevity; health; autonomy; safety, security and tranquill-

ity; equal opportunities and participation and influence. Nazarkina and Le Bocq’s (2006) list comprises improvement of objective living conditions, which subsumes a decent standard of living, and economic and social progress. They furthermore include reduction of disparities, inequalities and social exclusion, promotion of equal opportunities and finally, preservation of human capital, which subsumes education, occupational health and safety, security and social protection.

Looking at these definitions in more detail, there is a high degree of overlap. All definitions include aspects of health (and longevity) and equality. However, only Weidema (2006) and Dreyer et al. (2006) include ‘social inclusion’ through Weidema’s ‘participation and influence’ and ‘autonomy’ and Dreyer et al.’s ‘social membership’. Furthermore, Dreyer et al. (2006) and Nazarkina and Le Bocq (2006) to a larger extent emphasise ‘standard of living’ through the fulfilment of physical needs and improvement of objective living conditions, whereas Weidema (2006) emphasises ‘safety, security and tranquillity’. Finally Nazarkina and Le Bocq (2006) also include ‘human development’ through the focus on the development of skills and education. Based on these three approaches, an inclusive list of endpoint impact categories could therefore be: Health and longevity; equality; social inclusion; standard of living; human development and safety, security and tranquillity. It should here be noted that the point of establishing this inclusive list is not to come up with a ‘better’ AoP. In fact, an AoP can easily become too broad, and thereby overlap other AoPs resulting in double counting. The purpose here is merely to establish an AoP as inclusive as possible, which is needed for the following discussion.

For the definitions of the AoP focusing on the development and productivity of society, both Nazarkina and Le Bocq (2006) and Schmidt et al. (2004) conclude on the basis of the World Bank’s ‘Four Capital Approach’ that the AoP should include; ‘social capital’, subsuming social networks, associations and institutions tied by common norms and trustful relationships; human capital, subsuming people’s productive capabilities based on skills, education and health and finally, produced/physical capital, subsuming the stocks of machinery, factories, buildings and infrastructure and thereby representing an economic dimension. As may be noted, there are in some cases an overlap between the societal and individual AoP, which is quite reasonable considering that what is good for human well-being is often (but not always) good for the societal development, and vice versa.

### 3.2 Establishing the child labour impact pathways

Applying the incidence of child labour as an indicator in SLCA inherently assumes that it affects the endpoint

categories mentioned above and thereby also the AoP. Furthermore, in order to assess the damage on the AoP, the relation between the incidence of child labour and damage on the AoP has to be predictable, implying that a certain indicator ‘score’ will always result in the same impact on the AoP.

The impact pathway from the incidence of child labour to the two AoPs is attempted to be established based on available research from this field in order to assess the predictability of the relation.

A review of the literature on child labour quickly reveals that this is a complex issue. Working children may experience a series of different impacts ranging from acute to long-term and being of both a physical and a psychological nature, which may affect both the children and society in different manners. Below, these impacts are systematised and their relation to child labour is discussed. The analysis is based on statistical correlations and the conclusions drawn will therefore be on the average.

### 3.2.1 Health risks

One type of documented impacts from child labour is impacts on the child’s health. Referring to Fig. 1, impacts on health relates directly to both the AoPs through either ‘health and longevity’ or ‘human capital’ endpoint impact categories. A causal relationship thus clearly exists between child labour and damage to the AoPs, but the nature of the health risks depends strongly on the type of work (Fassa et al. 2000) and, as previously discussed in the SLCA community, on the management of the company (Dreyer et al. 2006; Spillemaeckers et al. 2004). Impacts may be fatal and non-fatal, including all kinds of acute, sub-acute or chronic impacts (Forastieri 2002). Therefore, the fact that a child works does not say very much about the impacts on health that the child experiences, implying that the incidence of child labour will not always result in the same type of damage on the AoP (in this case, impacts on ‘health and longevity’ or ‘human capital’).

### 3.2.2 Impacts on schooling outcomes

Another relatively well-documented impact from child labour is its impact on schooling outcomes. Schooling outcomes are represented by the endpoint category ‘human development’ (in the individual AoP) or ‘human capital’ (in the societal AoP), thereby establishing an impact pathway from the incidence of child labour to both AoPs. Child labour’s influence on schooling outcomes is something that has been addressed in numerous studies (See Amin and Quayes (2006) for a review). From an overall point of view, the tendency is that work affects schooling outcomes negatively; however, child labour’s influence on schooling

outcomes varies according to the amount of time used on work. It is debatable whether there exists a ‘threshold’ for the daily working time under which child labour does not affect schooling outcomes (Ray and Lancaster 2005), however, the overall conclusion seems relatively unambiguous: If the child has few hours of work, there may be a limited effect on the schooling outcomes, whereas long hours may significantly reduce schooling outcomes. Assuming that this conclusion can be generalised to other contexts, this implies that the impacts of child labour on education is not simply a question of either-or but a question of degree, meaning that a distinction should be made according to the conditions of the employment. An indication on whether or not a child is working does not predict the impact this may have on ‘human development’ or ‘human capital’ and thereby the AoP.

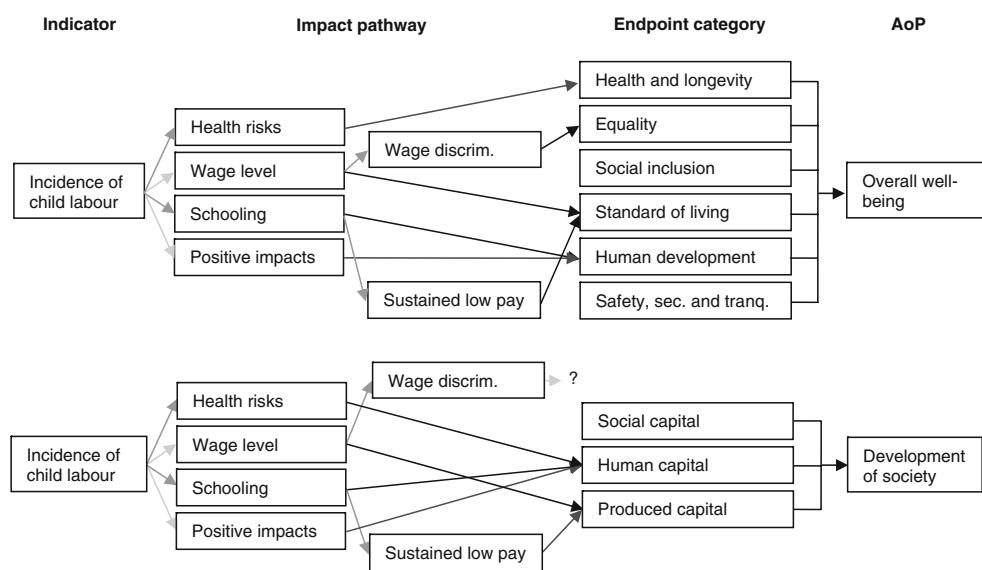
### 3.2.3 Wage level

The wage level may be understood in several ways. First of all, children are in some cases paid less than adults for the same amount of work (Levison et al. 1996). If discrimination is defined as putting group members at a disadvantage or treating them unfairly as a result of their group membership (Plous 2003) paying low wages to working children for equal work can be characterised as a sort of discrimination. In relation to the ‘individual AoP’ discrimination can be seen as the opposite of ‘equality’, and an impact pathway is thereby established. However, the extent to which children are paid less than adults for equal work varies with sector and country (ILO 2007). In some sectors and countries, there are no differences between child and adult pay whereas in other cases there are. Wage discrimination is therefore not a predictable result of child labour.

In relation to the ‘societal AoP’, wage discrimination or even discrimination is not included in the endpoint impact categories of the AoP, and it is therefore necessary to further model the impact pathway in order to find its potential relation to the AoP. However, no studies have been made documenting the potential impacts of wage discrimination among children, implying that the impact pathway from wage discrimination to the ‘societal AoP’ is uncertain, and thus also the impact pathway from child labour to the AoP in relation to this issue.<sup>8</sup>

<sup>8</sup> Several studies have been made addressing the consequences of discrimination (Williams (1999), Williams and Williams-Morris (2000)), yet, these studies relate to impacts of racial discrimination experienced in all parts of the everyday life and thus seem in many ways to differ from the impacts that may be suspected to affect children that are not paid as much as their elder colleagues, for example because wage discrimination only relates to the working life and because it only relates to a limited period of the person’s life. Thus simply assuming that the consequences of discrimination are also true for wage discrimination among children seems somewhat dubious.

**Fig. 1** The child labour impact pathway. The figure sums up the analyses from Section 3.2.1 to 3.2.4 and shows how a certain ‘amount’ of a given phenomenon, e.g. ‘incidence of child labour’ or ‘schooling outcomes’ affects next step in the impact pathway. A *black arrow* represents a relatively well-documented, predictable relationship; a *dark grey arrow* represents a relatively well-documented but unpredictable relationship; and a *light grey arrow* a potential, yet relatively undocumented and therefore potentially unpredictable relationship



Discrimination aside, studies also point to the possibility that working children later in life will have an increased risk of getting low pay (Ilahi et al. 2001). However, the studies propose that this may be an indirect result of reduced schooling outcomes, another effect of child labour as discussed above. If this is the case, then the aspect of ‘continual low pay’ should be accounted for in relation to schooling outcomes in order to avoid ‘double-counting’ child labour’s impact on schooling outcomes.

Finally, the child’s wage in cash or in kind, is often a necessary part of the family’s household (Basu and Van 1998) and has an impact on the family’s material well-being according to Fig. 1 which is directly related to the ‘individual AoP’. Also, seen isolated from its above effects, child wages will, as described above, increase the societal economic activity and will thus contribute to the produced or physical capital and thereby the ‘societal AoP’. However, as also mentioned above, wages from child labour vary implying that the incidence of child labour alone cannot predict the impact on the standard of living and produced/physical capital and thereby the AoP.

### 3.2.4 Positive impacts

Other effects on children from work, which in many respects are characterised as positive, may be the development of discipline, responsibility, self-confidence and independence; teaching children how to manage money and providing the child with working skills (Fassa et al. 2000; Edmonds and Pavcnik 2003). However, these impacts have not been thoroughly studied, and it is therefore difficult to state anything about how their effect on the AoP may vary according to the work activities.

Summing up, it seems that the incidence of child labour creates a series of both well-documented and of relatively

undocumented damages and benefits on the AoPs, but that these damages and benefits may vary significantly according to the character of the work. The findings have been summarised in Fig. 1 (please see figure text for explanations). Thus, using the incidence of child labour alone as a measure for impacts on the AoP entails high degrees of uncertainty. To reduce this uncertainty, the indicator for child labour could be moved from a registration of the mere incidence to the next or second step in the impact pathway (towards the right in Fig. 1), as the impacts on the AoP in both cases seem more predictable from indicators chosen at this level.

### 3.3 Problems related to substitution of the child labour indicators in SLCA

Even though the accuracy of SLCA may be improved by replacing the assessment of the incidence of child labour with indicators on ‘health risks’, ‘schooling outcomes’, ‘wage levels’, ‘positive impacts’ and ‘sustained low pay’ (and ‘wage discrimination’ in relation to the AoP focussing on the individual), this also entails several problems that need to be considered.

A practical problem relating to the proposed alternative indicators of child labour impacts is connected to their modelling. For example, it is not feasible to directly measure work’s impacts on schooling outcomes. Instead, a model has to be established enabling the development of an indicator. One suggestion could be to estimate the impact based on the number of hours the child works each day, which according to the literature reviewed in section 3.2.2 seems to be a good indication. However, since there are no studies on the exact quantitative relationship between hours worked per day and schooling outcomes, a semi-quantitative approach may be needed, for example using a

scale ranging from ‘no impacts on schooling outcomes’ to ‘severe impacts on schooling outcomes’ corresponding to ‘few hours of work’ to ‘full-time work’ as indicated in section 3.2.2. As with any model, it introduces some uncertainty, since even though there is a statistical correlation between working hours and schooling, there may be situations where working hours will have no influence on schooling outcomes, for example if the child lives too far away from a school rendering schooling impossible in any case. When relying on statistical analyses as referred above, there will therefore be situations where the assumed correlation between working hours and schooling will be incorrect. It could therefore be argued that even more detailed indicators than the ones proposed here are necessary, e.g. indicators also addressing distance to school, etc. To what extent such more nuanced indicators should be developed in relation to ‘schooling’ as well as for the other areas mentioned in this article, will not be discussed further here. However, if later scholars find this necessary, the approach of modelling impact pathways as used here will be applicable.

Direct measurement of ‘positive impacts’, such as the development of skills, would also be impossible to establish since many of these seem to be impacts created over time. Some assumptions about the type of work and the development of skills would therefore have to be established.

Another practical problem in the choice of indicators is the accessibility of data as data on child labour in general is scarce. The suggested introduction of new indicators are likely to intensify it, since they require a more detailed assessment of the type of child labour, for example hours of child labour, instead of the simpler overall indicator on the incidence of child labour. However, in some cases, some approximations seem possible. For example in relation to the health risks of child labour, studies show that the risk of these impacts happening is highly sector specific. Agriculture is ranked among the most hazardous industries for children due to the widespread use of dangerous machinery, strenuous labour and handling of chemicals (Fassa et al. 2000). The construction sector is also one of the most hazardous working environments with regard to the risk of accidents (*ibid.*). Industry has specific hazards linked to each production process depending on the tasks performed. Yet, health hazards tend not to arise from the production process but from the management of the production facilities, making it difficult to state anything about the general risk level (*ibid.*) but on an overall level manufacturing industries are found to have lower levels of self-reported accidents than agriculture (Edmonds and Pavcnik 2003). And finally, regarding the retail sector the main problems may be connected to long hours of work and changing schedules, often entailing work late at night and difficulties to combine work and school (Fassa et al. 2000),

but from a health perspective seemingly less hazardous. As these examples show, it may in some cases be possible to make usable approximations. But also here, it is likely that a semi-qualitative approach may have to be taken, as no data exist on the exact number and severity of child labour health impacts in the different sectors. Scores on health risks may therefore range from ‘high’ if the child is working in agriculture or construction, to ‘low’ if the child works in the retail sector.

Furthermore, changing the indicators of child labour also involves potential conflicts with the political reality of the context in which the SLCA is to be used and communicated. In the present debate, child labour is often considered by principle rather than by consequence. By focussing on the consequence on the AoP, SLCA diverges from this practice, since according to the proposed indicators above the incidence of child labour should only be included in the assessment if it is associated with health risks, effects on schooling outcomes, etc. Here, decision makers may be caught between two concerns: on one side the concern for the public opinion and on the other the concern for the actual consequence for, in this case, the impacted child. For example, looking at the use of SLCA in a company context, it is doubtful whether a company could communicate successfully to its stakeholders that child labour in some forms may be acceptable. Rather, a company would probably try to be in concordance with the general public opinion, which presently is that all sorts of child labour should be avoided in the product chain. The consequence of changing indicators as suggested here may thus be a reduction in relevance of SLCA for selected user groups, since results will address consequence and not principles.

Considering the high sensitivity of the social area in general, this dilemma between political reality on one side and science on the other creates a difficult milieu for performing assessments. On one hand, it has to relate to issues considered as important in the political debate, but on the other hand, the scientific and theoretical foundation for the assessment, in this case the empirically supported impact pathways, has to be acknowledged. In some cases, these two aims may be difficult to combine.

Here, it is important to note that the focus on a valid scientific base for the assessment is not just a scholastic exercise. On the contrary, if it is assumed that decisions to be based on the assessment results will have an actual consequence for the impacted stakeholders it is of outmost importance that the results of the assessment reflect the resulting damage on the impacted stakeholder. Wrong answers may even in some cases create negative impacts for the stakeholders. For example, by assessing the actual damage to the working child, the assessment may, through focusing on the child labour that creates negative impacts,

contribute to the abolishment of the worst forms of child labour, whereas an assessment focusing only on the incidence of child labour may through a ban of all kinds of child labour contribute to reducing the demand for child labour in the life cycle of the product. But since working children are generally forced to work due to poverty (Basu and Van 1998), a simple ban could force the affected children to take other, potentially worse, jobs.

If companies or other decision makers were more interested in child labour by principle than by consequence, it would not merely be a question of choosing indicators but rather AoPs, since in this case, ‘the incidence of child labour’ would become an AoP of itself, making this whole discussion of consequence irrelevant. The SLCA should in this case be based on a deontological ethics instead of a consequential ethics normally connected to the LCA methodologies.

As a final comment to the ‘incidence of child labour’ it should here be noted that we do not in this article in any way suggest that the ILO conventions on child labour are irrelevant. International conventions like these are in general important documents and also for SLCA when it comes to identifying important social concerns which should be covered by an SLCA. But in connection to this, it is important to remember that the purpose of the conventions and SLCA as presented here probably are different: Whereas the conventions are probably based on the ideal of establishing generally applicable recommendations for e.g. how work should be performed, the purpose of SLCA as presented here is to assess as valid as possible the consequence to the AoP of e.g. a specific type of work. A general recommendation in relation to child labour should be to abolish the ‘incidence of child labour’ as claimed by the ILO because it often carries with it severe impacts to the child, as documented above. But as was also documented above, the actual impacts vary depending on the work, and it is the actual impacts we are interested in assessing in an SLCA as presented here. So, even though we recognise the importance of the themes covered by the various international conventions, the conventions can not necessarily be used directly as indicators in an SLCA with the goal of assessing impacts on an AoP as accurately as possible.

### 3.4 Summing up on example 2

By analysing the often included indicator in SLCA, the ‘incidence of child labour’, we have shown that several well-documented impact pathways links it to the AoPs, but that the mere fact that a child works does not support an accurate prediction of the actual damage (or benefits) to the AoP.

The analysis shows that indicators further along the impact pathway should be considered. Yet, as was discussed in section 3.3 there are several other concerns than only validity, such as issues concerning feasibility of

indicator development, data availability and the political reality surrounding the SLCA.

Regarding the methodological and practical issues, the development of other child labour indicators which represent damage on the AoP in a more accurate manner seems manageable, but the increased demand for data that they entail may intensify the problem of getting data concerning child labour. Yet, approximations can to some extent mitigate this problem.

The choice of indicators will probably for many decision makers also depend on the focus of the audience and main stakeholders of the assessment. But if the goal of SLCA is to improve the social impacts that affect, in this case, the working children, an accurate assessment of impact on the AoP has to be a first priority, since what matters for the children is how they are impacted and not how this is perceived by the audience of the assessment.

## 4 Conclusion and perspectives

Digging deeper into the impact pathways underlying current approaches to SLCA has revealed that validity in several regards may be improved. The primary reason for this is clearly that since SLCA is a very young field of research the need for theoretically well-founded impact pathways is a research task which still has to be addressed in a consistent way. In line with this, we therefore point to the need for analysing the impact pathways for other impact categories currently addressed in SLCA, which may show the same problems as identified above (see Jørgensen et al. (2008) for examples of other impact categories).

So, in spite of the problems identified for current SLCA approaches, there is a positive message from the work underlying this article: it demonstrates the possibility of analysing and assessing the validity of the impact pathways applied in SLCA, as it is done in ELCA. It may (still) be difficult to make a quantification of the indicator results in terms of impacts on the AoP as is to some extent possible in ELCA, but the qualitative analyses performed here take us the first step in identifying the (type of) indicators which can measure what we intent to measure in a more valid way. The analyses also showed that the increase in validity may come at a certain price in terms of loss of practicability, usability and even the introduction of new uncertainties. Future work may therefore show how compromises between validity, usability and practicability can be made. These analyses therefore does not give any final answers of how to conduct an SLCA but they illustrate how validation standards can be applied to SLCA enabling the development of a theoretically well-founded methodology, which will be necessary if SLCA is to develop as an acknowledged tool for decision support.

## References

Amin S, Quayes S (2006) Market work and household work as deterrents to schooling in Bangladesh. *World Dev* 34(7):1271–1286

Barthel L, Wolf MA, Eyerer P (2005) Methodology of life cycle sustainability for sustainability assessments. Presentation on the 11th Annual International Sustainable Development Research Conference (AISDRC), 6th–8th of June 2005, Helsinki, Finland

Basu K, Van PH (1998) The economics of child labor. *Am Econ Rev* 88(3):412–427

Berger-Schmitt R, Noll H (2000) Conceptual framework and structure of a european system of social indicators', EU Reporting Working Paper No. 9, Mannheim, Germany. [http://www.gesis.org/fileadmin/upload/dienstleistung/daten/soz\\_indikatoren/eusi/paper9.pdf](http://www.gesis.org/fileadmin/upload/dienstleistung/daten/soz_indikatoren/eusi/paper9.pdf)

Benoît C, Mazijn B (2009) Guidelines for social life cycle assessment of products. UNEP/SETAC Life Cycle Initiative, Druk in de weerd, Belgium

Burrell G, Morgan G (1979) Sociological paradigms and organisational analysis. Ashgate Publishing Limited, Aldershot, England

Carley M (1981) Social measurement and social indicators: issues of policy and theory. G. Allen, Boston, USA

Carmines EG, Zeller RA (1979) Reliability and validity assessment: reliability and validity assessments. Sage, Beverly Hills, USA

Cummins RA (2000) Objective and subjective quality of life: an interactive model. *Soc Indic Res* 52(1):55–72

Cummins RA (2005) Moving from the quality of life concept to a theory. *J Intell Disabil Res* 49(10):699–706

Diener E, Suh E (1997) Measuring quality of life: economic, social and subjective indicators. *Soc Indic Res* 40(1–2):189–216

Diener E, Biswas-Diener R (2002) Will money increase subjective well-being? *Soc Indic Res* 57(2):119–169

Diener E, Lucas R, Oishi S (2002) Subjective well-being: the science of happiness and life satisfaction. In: Snyder CR, Lopez SJ (eds) Handbook of positive psychology. Oxford University Press, New York

Dreyer L, Hauschild M, Schierbeck J (2006) A framework for social life cycle impact assessment. *Int J Life Cycle Assess* 11(2):88–97

Earthster (2008) [www.earthster.org](http://www.earthster.org)

Edmonds EV, Pavcnik N (2003) Child labor in the global economy. *J Econ Perspect* 19(1):199–220

Fassa AG, Facchini LA, Dall'Agnol MM, Christiani D (2000) Child labor and health: problems and perspectives. *Int J Occup Env Heal* 6(1):55–62

Felce D, Perry J (1996) Assessment of quality of life. In: Quality of Life, Volume I: Conceptualization and measurement. American Association on Mental Retardation, Washington DC, US

Flysjö A (2006) Indicators as a complement to life cycle assessment – a case study of salmon. Presentation held 17th of June 2006 in Lausanne

Forastieri V (2002) Children at work: health and safety risks, 2nd edn. International Labour Organisation, Genova, Switzerland

Galloway S (2006) Quality of life and well-being: measuring the benefits of culture and sports: literature review and thinkpiece. Centre for Cultural Policy Research, University of Glasgow. <http://www.scotland.gov.uk/Publications/2006/01/13110743/0>

Gauthier C (2005) Measuring corporate social and environmental performance: the extended life-cycle assessment. *J Bus Ethics* 59 (1–2):199–206

Grießhammer R, Benoît C, Dreyer LC, Flysjö A, Manhart A, Mazijn B, Méthot A, Weidema BP (2006) Feasibility study: Integration of social aspects into LCA. Discussion paper from UNEP-SETAC Task Force Integration of Social Aspects in LCA meetings in Bologna (January 2005), Lille (May 2005) and Brussels (November 2005). Freiburg, Germany

Hunkeler D (2006) Societal LCA methodology and case study. *Int J Life Cycle Assess* 11(6):371–382

Hunkeler D, Rebitzer G (2005) The future of life cycle assessment. *Int J Life Cycle Assess* 10(5):305–308

Ilahi N, Orazem P, Sedlacek G (2001) The implications of child labor for adult wages, income and poverty: retrospective evidence from Brazil, Mimeo, Iowa State University, USA. [http://www.grade.org.pe/Eventos/nip\\_conference/private/sedlacek-%20child\\_labor%20retros.pdf](http://www.grade.org.pe/Eventos/nip_conference/private/sedlacek-%20child_labor%20retros.pdf)

ILO (2007) Child labour wages and productivity: results from demand side surveys. International Programme for the Elimination of Child Labour (IPEC) under the International Labour Organisation, Geneva, Switzerland

Jørgensen A, Le-Bocq A, Nazarkina L, Hauschild M (2008) Methodologies for social life cycle assessment. *Int J Life Cycle Assess* 13(2):96–103

Jørgensen A, Hauschild M, Jørgensen MS, Wangel A (2009) Relevance and feasibility of social life cycle assessment from a company perspective. *Int J Life Cycle Assess* 14(3):204–214

Klöppfer W (2003) Life-cycle based methods for sustainable product development. *Int J Life Cycle Assess* 8(3):157–159

Klöppfer W, Udo de Haes H (2008) Life cycle sustainability assessment of products (with comments by Helias A. Udo De Haes). *Int J Life Cycle Assess* 13(2):89–95

Labuschagne C, Brent AC (2006) Social indicators for sustainable project and technology life cycle management in the process industry. *Int J Life Cycle Assess* 11(1):3–15

Levison D, Richard A, Shahid A, Sandhya B (1996) Is child labour really necessary in India's carpet industry? Labour market papers 15. Employment Department, International Labour Organisation, Geneva, Switzerland

Manhart A, Grießhammer R (2006) Social impacts of the production of notebook PCs – contribution to the development of a product sustainability assessment (PROSA). Öko-Institut e.V, Freiburg, Germany

Martel JP, Dupuis G (2006) Quality of work life: theoretical and methodological problems, and presentation of a new model and measuring instrument. *Soc Indic Res* 77(2):333–368

Méthot A (2005) FIDD: a green and socially responsible venture capital fund. Presentation on the Life Cycle Approaches for Green Investment—26th LCA Swiss Discussion Forum, 2005, Lausanne, Switzerland

Michalos AC (2001) Social indicators research and health-related quality of life research. *Soc Indic Res* 65(1):27–72

Nazarkina L, Le Bocq A (2006) Social aspects of sustainability assessment: feasibility of social life cycle assessment (S-LCA). EDF 2006, Moret-sur-Loing, France

Norris GR (2006) Social impacts in product life cycles—towards life cycle attribute assessment. *Int J Life Cycle Assess* 11(1):97–104 (special issue)

Plous S (2003) The psychology of prejudice, stereotyping, and discrimination: an overview. In: Plous S (ed) Understanding prejudice and discrimination. McGraw-Hill, New York, US

Ray R, Lancaster G (2005) The impact of children's work on schooling: multi-country evidence. *Inter Labour Rev* 144(2):189–210

Rain JS, Irving ML, Steiner DD (1991) A current look at the job satisfaction/life satisfaction relationship: review and future considerations. *Human Relat* 44(2):287–307

Schalock RL (1996) Reconsidering the conceptualization and measurement of quality of life. Quality of life, Volume I: conceptualization and measurement. American Association on Mental Retardation, Washington DC, USA

Schalock RL, Brown I, Brown R, Cummins RA, Felce D, Matikka L, Keith KD, Parmenter T (2002) Conceptualization, measurement, and application of quality of life for persons with intellectual

disabilities: report of an international panel of experts. American Association on Mental Retardation 40(6):457–470

Schmidt I, Meurer M, Saling P, Kicherer A, Reuter W, Gensch C (2004) SEEbalance—managing sustainability of products and processes with the socio-eco-efficiency analysis by BASF. Greener Manage Int 45:79–94

Sirgy MJ, Michalos AC, Ferriss AL, Easterlin RA, Patrick D, Pavot W (2006) The quality-of-life (QOL) research movement: past, present, and future. Soc Indic Res 76(3):343–466

Spillemaeckers S, Vanhoutte G, Taverniers L, Lavrysen L, van Braeckel D, Mazijn B, Rivera JD (2004) Integrated product assessment—the development of the label ‘sustainable development’ for products ecological. Social and Economical Aspects of Integrated Product Policy, Belgian Science Policy, Belgium

Staines GL (1980) Spillover versus compensation: a review of the literature on the relationship between work and nonwork. Hum Relat 33(2):111–129

Tait M, Padgett MY, Baldwin TT (1989) Job and life satisfaction: a re-evaluation of the strength of the relationship and gender effect as a function of the date of the study. J Appl Psychol 74(3):502–507

Udo de Haes HA, Jolliet O, Finnveden G, Hauschild M, Krewitt W, Müller-Wenk R (1999) Best available practice regarding impact categories in life cycle assessment. Int J Life Cycle Assess 4 (2):66–74

Weidema BP (2006) The integration of economic and social aspects in life cycle impact assessment. Int J Life Cycle Assess 11(1):89–96 (special issue)

WHO (1995) The world health organization quality of life assessment (WHOQOL): Position paper from the World Health Organization. Soc Sci Med 41(10):1403–1409

Williams DR (1999) Race, socioeconomic status, and health: the added effects of racism and discrimination. An New York Acad Sci 896:173–188

Williams DR, Williams-Morris R (2000) Racism and mental health: the African-American experience. Ethnic Health 5(3–4):243–68

World Bank (1997) Expanding the measures of wealth: indicators of environmentally sustainable development. Environmentally sustainable development studies and monographs series no. 17. The World Bank, Washington, USA